calls and the number of toll minutes of use do not accurately account for the diverse

rate elements in local and long distance revenue. Unlike Norsworthy's two physical

measures of intrastate output, the quantity measures in our TFP model account for this

diversity. Rate changes for each local and long distance service are accurately

aggregated in the price indexes for local and long distance service. This leads to

quantity indexes for local and long distance service that accurately reflect the mix of

local and long distance services.

VI.   The Simplified Christensen TFP Model correctly uses revenue weights to measure Total Output.

In Appendix 1 to our original TFP study report we provided a detailed

explanation of why revenue weights should be used to measure total output when

establishing a TFP benchmark.[20] We also noted in our comments that previous

research into the measurement of telephone industry TFP shows that using cost

elasticity (i.e. marginal cost) weights leads to substantially lower estimates of TFP

growth.[21] Any "new" research that purports to reverse this relationship must be viewed

very critically. Dr. Norsworthy cites the difficulties he previously has had in obtaining

meaningful marginal cost estimates for the Postal Service,[22] he also admits that

econometric estimates of marginal cost are often highly sensitive to small changes in

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[20] This issue is also addressed in NERA's report, "Economic Performance of the LEC Price Cap Plan," May 1994; and in William E. Taylor, Timothy J. Tardiff, and Charles J. Zarkadas, "Economic Evaluation of Selected Issues From the Fourth Further Notice of Proposed Rulemaking in the LEC Price Cap Performance Review: Reply Comments," NERA, March 1, 1996.
[21] Christensen comments, p. 7
[22] Norsworthy report, pp. 60-61

the model.[23] It is highly unlikely that Dr. Norsworthy would be able to develop a reasonable verifiable panel data set for estimating marginal costs, particularly since his measures of LEC outputs and inputs are fatally flawed (as discussed herein).

Because the data to estimate marginal cost weights may not be publicly-available, and because it is quite unlikely that good marginal cost estimates will be derivable from econometric methods, marginal cost weights are not an appropriate choice for the TFP model used to determine an X factor. Moreover, previous research into this area shows that the use of marginal cost weights would actually lower the X-factor. Any investigation into marginal cost weights is unwarranted. As we have consistently stated, a total output index based on revenue weights is appropriate for establishing an X factor in this proceeding.

VII.   The Christensen Simplified TFP Model includes both debt and equity components in the opportunity cost of capital in an appropriate manner..

The Norsworthy and ETI reports criticize our cost of capital measure for not including both debt and equity components and for incorrectly treating the tax effect of debt versus equity.[24] While changes in Moody's bond yield provide a good proxy for changes in the LEC cost of capital for purposes of measuring LEC TFP growth, it does not incorporate an equity component. To address this concern, in the simplified model we have used the cost of capital for the U.S. economy, which includes both debt and

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[23] Norsworthy report, p. 59.
[24] Norsworthy report, pp. 45-47, ETI report, p. 20.

equity components. All the data used to compute the U.S. economy cost of capital are produced by the U.S. Bureau of Economic Analysis , are publicly available, and are included in the TFPRP. As we discussed in our comments, year-to-year changes in the U.S. economy cost of capital[25] provide a good measure of year-to-year changes in the telephone industry opportunity cost of capital.

Both ETI and Dr. Norsworthy incorrectly assert that our model overstates the price level of capital because it does not address the different tax implications of debt and equity financing. This incorrect assertion apparently arises from their misunderstanding of the data used in our models to compute the effective tax rate on capital income. Dr. Norsworthy's Attachment 2, which he attempts to use to prove his point, demonstrates that the effective tax rate on income generated by capital is less than the statutory tax rate on corporate profits, because some of the income generated by capital is paid out as interest on debt, and this interest on debt is not taxed. The only conclusion to be drawn from this analysis is that the statutory tax rate on corporate profits is a biased proxy for the effective tax rate on income generated by capital.

Neither the original LEC TFP model nor the simplified LEC TFP model uses the statutory tax rate as a proxy for the effective tax rate on income generated from capital. Instead, as we stated on page 8 of our original study, the tax on capital income is based on the taxes reported in the Form M. It is appropriate to develop the effective tax rate from taxes actually paid, since they reflect the fact that interest on debt is not subject to corporate profits taxation. Therefore, even if we were to continue using Moody's bond

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[25] See Christensen comments, pp. 9-12.

yield as a proxy for the cost of capital, the tax component of the rental price formula would properly account for the differential tax treatment of debt and equity, since we use actual taxes paid to compute the effective tax rate.

VIII.   Dr. Norsworthy incorrectly asserts that our model is based on an unsound assumption that capital inputs are adjusted at all times to cost-minimizing levels.

Dr. Norsworthy asserts that a critical assumption to our model is that LEC capital inputs are always adjusted to their cost-minimizing levels.[26] He then goes on to speculate that such an assumption does not hold true in the real world. Dr. Norsworthy offers no convincing evidence that this assumption undermines our model; nor does he recognize that to whatever extent his criticism is valid, it would apply equally to his Performance-Based Model.

Norsworthy's point is that the marginal product, or "shadow price" of an input is not equal to its market price if that input is not at its optimal level. When this is true, conventional measures of TFP, which employ market prices to weight inputs, will not represent shifts in the production function over time. The alternative to conventional measurement of TFP is the econometric estimation of a variable cost function. Norsworthy acknowledges the difficulties in obtaining robust results from econometric analysis. Because of the increased difficulty, the econometric approach should be undertaken only when there is a strong indication that inputs are far from their optimal level. One example was the research conducted by Drs. Christensen and Brown, cited

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[26] Norsworthy report. pp. 31-32.

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by Norsworthy, that addressed productivity in the agricultural sector. At the time of their research, a widely recognized agricultural policy problem was that self-employed farmers and their land were not at optimal levels; therefore it was important for Christensen and Brown to explicitly address this. Another example is research conducted on the railroad industry before deregulation, where it was widely recognized that railroads were not allowed to shed excess track. There is no evidence that the telephone industry faces problems nearly as great. Therefore there is no compelling reason to undertake the extremely difficult and contentious effort to econometrically estimate cost functions for the LECs.

Norsworthy's "evidence" that capital stocks are not at their optimal level is that variation in the net capital stock is not as great as variation in the return to capital. This does not imply that the capital stock does not adjust to its cost-minimizing level; at best it suggests that capital is an inelastic input (i.e., that its own price elasticity is low). Furthermore, the telephone industry does not suffer the major factor that creates capacity utilization problems in certain other industries--highly cyclical variations in output.

Norsworthy concludes that short of estimating an econometric cost function for the telephone industry, one must use total revenue to estimate the cost of capital. He bases his conclusion on two erroneous assertions: the economic theory of production requires it, and regulatory authorities mandate it. Norsworthy offers no proof that economic theory requires it; in fact economic theory holds that this approach is wrong for regulated industries with non-constant returns to scale--including the LEC industry.

Regarding any "regulatory mandate" that revenue equals cost, regulatory agencies may periodically attempt to set rates in order to cover accounting costs. But it is widely recognized that rate-of-return regulation does not equate cost and revenue on a year-to-year basis. Therefore it is incorrect to infer that total cost is equal to total revenue in every year.

IX. Dr. Norsworthy and ETI incorrectly claim that the price indexes for capital must be hedonically adjusted for quality changes in plant and equipment.

Dr. Norsworthy and ETI propose that the LEC capital prices be adjusted for changes in quality.[27] This proposal should be rejected for two reasons. First, such an adjustment would be speculative and based on unpublished research. It therefore does not meet the Commission criterion that the calculation be reasonably simple and based on accessible and verifiable data. Second, inclusion of a quality adjustment in the LEC capital input measure would lead to a serious asymmetry between measured LEC TFP and U.S. economy TFP.

The adjustments made by Norsworthy and ETI are undocumented and *ad hoc.* In his Performance-Based Model, Dr. Norsworthy makes a 3.3 percent per year adjustment to the price of capital, based on some of his previous unpublished research. No details or documentation are provided regarding the methods employed in that study, nor does Norsworthy discuss whether the price indexes analyzed in that research are at all comparable to the capital price index in the USTA or Performance-

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[27] Norsworthy report, pp. 49-58.

Based Model. ETI suggests a "modest" 10 percent per year adjustment be made to telephone asset price deflators,"[28] but provides no evidence justifying an adjustment of such magnitude. Furthermore, Dr. Norsworthy and ETI do not recognize the fact that any changes in their input price indexes resulting from the adjustment will be largely offset by changes in their TFP measures. Any quality adjustment that reduces the rate of input price growth will also increase the rate of input quantity growth. This will in turn lead to decreases in the rate of TFP growth. In fact, ETI ignores the magnitude of this impact on TFP when it incorrectly asserts that the adjustment will lead to a "significantly higher" X factor.[29]

Dr. Norsworthy and ETI also fail to make necessary symmetric adjustments to prices in the U.S. economy. The research cited by Norsworthy and ETI concludes that quality change is present for a wide variety of goods and services in the U.S. economy. Symmetric treatment of the quality issue would require quality adjustments to all prices going into the Gross Domestic Product Price Index (GDPPI) and U.S. economy TFP. Asymmetric treatment of this issue will lead to biased results.

Since the prices indexes for capital in the Simplified Christensen TFP model are Bureau of Economic Analysis price indexes, it treats the quality issue symmetrically. Whatever quality adjustments BEA and BLS make to prices in the GDPPI and U.S. economy TFP are also incorporated in the Simplified Christensen TFP model.

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[28] ETI report, p. 57.
[29] ETI report, p. 42.

X. Dr. Norsworthy and ETI incorrectly represent the depreciation rates used in the USTA TFP study.

Dr. Norsworthy incorrectly asserts that our depreciation rates are taken directly from Hulten and Wykoff[30] and therefore based on a study that ended in 1971 and contained no data on telephone assets. ETI makes similar assertions about our study being based on an old and outdated study. As we have previously stated, the depreciation rates used in the simplified TFP model are taken directly from Jorgenson.[31] A comparison of the rates found in Jorgenson with those published by Hulten and Wykoff show that Jorgenson's depreciation rates did not "come from the Hulten-Wykoff study" as Dr. Norsworthy claims.[32] The derivation of the Jorgenson rates is correctly described in our comments.[33] The depreciation rates are derived from (1) a relationship developed by Hulten and Wykoff between the economic depreciation of an asset and its expected useful life and (2) the expected useful lifetimes currently used by the U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics in their capital measures. The expected lifetimes used by the BEA and BLS are independent of the Hulten-Wykoff research.

Norsworthy's criticism that Christensen was not forthcoming about the source of the depreciation rates is entirely false.[34] We believe by using the rates employed by Dr. Jorgenson, one of the foremost experts on productivity, we were using the best

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[30] Norsworthy report, p. 48.
[31] D.W. Jorgenson, "Productivity and Economic Growth," in E.R. Berndt and J.E. Triplett, eds. Fifty Years of Economic Measurement, (Chicago: University of Chicago Press, 1990), pp. 19-118.
[32] Norsworthy report, p. 48, fn. 23.
[33] Christensen comments, pp. 12-13.
[34] Norsworthy report, p. 48, fn. 23.

gross stock is replaced with book value of gross stock reported in ARMIS/Form M. Because book value of gross stock does not account for economic depreciation or changes in the purchase prices of new assets over time, it needs to be multiplied by its own Economic Stock Adjustment Factor. This factor is computed with publicly-available data collected by the Bureau of Economic Analysis.[37]

XII. The materials price index used in our model accurately reflects the prices LECs pay for their materials.

The Christensen simplified TFP model uses the Gross Domestic Product Price Index to represent the prices paid by LECs for their materials. Dr. Norsworthy proposes that the materials price index be derived from the 1977, 1987, and 1993 input/output tables of the U.S. economy and the Producer Price Indexes and Consumer Price Indexes for those industries that the input/output tables indicate sell goods and services to the telephone industry.[38] The Norsworthy price index does not meet the FCC's criteria of accessibility and verifiability, since it is the result of a complex set of computations that are not documented. As a result, Norsworthy's suggested material price index should be rejected.

The Norsworthy price index suffers from an additional major shortcoming, namely that it is based only on transactions between the telecommunications industry and firms outside the telecommunications industry. This shortcoming leads to biased

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[37] See Christensen comments, pp. 14-17.
[38] Norsworthy report, pp. 18-19.

available information on depreciation relevant to productivity research. Furthermore, because these depreciation rates are based on lifetimes currently used by BEA and BLS, they also accomplish the needed symmetry between measured LEC capital input and measured U.S. economy capital input. We have previously recommended that on an ongoing basis the LEC economic depreciation rates be tied to the expected lifetimes used by BEA and BLS for the comparable analysis of U.S. productivity. We stand by this recommendation.

XI. Dr. Norsworthy and ETI incorrectly assert that net book value should be used instead of a capital stock measure constructed from economic depreciation.

Both Dr. Norsworthy and ETI advocate the use of net book value of plant and equipment to construct capital.[35] In our previous comments, we discuss why the book value of net stock cannot be used in a TFP study unless it is adjusted to account for (1) inflation in the purchase prices of new assets and (2) any differences between book depreciation and economic depreciation. Failure to make these adjustments is inconsistent with standard practice in productivity research, and inconsistent with the methods employed by the U.S. Bureau of Labor Statistics in their multi-factor productivity measures.[36] Because of these inconsistencies, Norsworthy's and ETI's recommendation should be rejected.

In the current Christensen simplified TFP study, the benchmark current cost of

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[35] Norsworthy report, p. 70, ETI report, pp. 24-25.
[36] Christensen comments. p. 17.

estimates of the materials price index. To correctly compute a materials price index for the LECs, one must look at the transactions between the LECs and all other entities-- including transactions between the LECs and other parts of the telephone industry. The remainder of the telephone industry includes not only other telecommunications companies, but also other subsidiaries of the LEC's holding company. For example, services that a Regional Holding Company headquarters supplies to one of its Regional Bell Operating Companies is considered LEC purchased "materials." Due to consolidation of many activities at the headquarters level, these types of arrangements have increased considerably in recent years. The Norsworthy price index does not capture this activity. This omission may be a significant reason for the difference between the Norsworthy materials price index and the Gross Domestic Product Price Index (GDPPI). Over the 1988-1994 time period Norsworthy's price index grows at an average annual rate of only 2.5%, substantially below the GDPPI rate of growth 3.6%.

Because the Norsworthy price index has a major conceptual flaw, and because it requires a complex set of undocumented computations, it does not represent an improvement to the GDPPI. Therefore, we believe there is no justification for using the Norsworthy price index in the simplified TFP model.

XIII.   **The ETI report continues to misinterpret the issues surrounding input prices and provides no credible evidence that there should be an input price differential in the price cap formula.**

In establishing an X factor, one must use the most relevant historical evidence for

predicting the future. Basing expectations of future input price growth solely on an arithmetic average of volatile input price growth rates for the 1984-1993 period does not adequately address the problems of input price volatility and anomalies in the cost of capital for the telephone industry and U.S. economy. Therefore, we believe the FCC should use the long term historical trends in input price growth for setting the input price component of the X factor.

The key in developing a forward-looking X factor is finding the best predictor of X--i.e., determining its expected value. In both the case of the TFP growth differential and the input price growth differential, the best predictor is the long-term historical value of the differential. For the TFP growth differential, the long-term value has remained stable over time at about 2 to 3 percent, and shows no signs of increasing. For the input price differential, the long-term value is zero and is subject to short-term fluctuations around this trend. Short-term fluctuations in one direction are likely to be followed by short-term fluctuations in the other direction. The volatility of this series is so great that observed differences cannot be statistically distinguished from a difference of zero, meaning there is no statistical basis for using an observed short-run input price growth differential as a projection of future trends.[39]

Input Prices in the California State Proceeding. The ETI report discusses the debate over input prices in a recent proceeding in California. In his California testimony,

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[39] In its reply comments, "Economic Evaluation of Selected Issues From the Fourth Further Notice of Proposed Rulemaking in the LEC Price Cap Performance Review: Reply Comments," NERA provides a detailed review of the statistical analyses previously applied to the input price differential and rebuts the assertions of Dr. Norsworthy on this issue.

Dr. Selwyn relied extensively on the Bush and Uretsky analysis found in Appendix F of the

First Report and Order in the current proceeding. As Dr. Christensen pointed out in his

rebuttal testimony in the California proceeding, Selwyn's interpretation of the Bush/Uretsky

analysis from Appendix F of the FCC's First Report and Order in CC Docket 94-1 is

incorrect.[40] Bush and Uretsky specifically focus on the 1984-90 period and were seeking

the actual input price growth differential for this period:[41]

> "We reach a finding in this Appendix specifically with respect to the period 1984-
> 1990, because this is the period that is relevant for purposes of corroborating the
> findings of the recalculated "Frentrup-Uretsky" study that the X-Factor during the
> period 1984-1990 was 5.0 percent."

In fact, Dr. Selwyn's quote of the Bush/Uretsky analysis on pages 38-39 of his

testimony leaves no doubt that the issue is the appropriate input price growth

differential for only that period: "..we believe that the input price differential for the 1984-

1990 period should be based on data from that period".[42] Bush and Uretsky did not

suggest the 1984-1990 input price differential be used as a predictor of the input price

differential for 1996 or beyond.

The ETI report states that nothing offered in California by Dr. Christensen, Dr.

Schmalensee, or Dr. Duncan refutes the Bush/Uretsky conclusion.[43] The ETI report

distorts the ultimate judgment of the evidence placed on the record in the California

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[40]Reply Testimony of Dr. Laurits R. Christensen, Investigation No. 95-05-047, Public Utilities Commission
of the State of California, September 18, 1995, p.10.
[41] C. Anthony Bush and Mark Uretsky, "Input Prices and Total Factor Productivity," CC Docket 94-1, April
7, 1995, Appendix F, p.2, fn. 7.
[42] Bush and Uretsky, p. 14.
[43] ETI Report, p. 34.

proceeding. The recent decision in the California proceeding cited in the ETI report

rejected Dr. Selwyn's proposal to include an input price differential in the X factor:[44]

> "Although we find the arguments of Dr. Selwyn on "input price differentials" theoretically interesting, we conclude that there is no basis for concluding that an empirical input price differential will exist in the next three years, or that it exists today
>
> Indeed, the record contains substantial evidence that the input price differential between the telecommunications industry and the U.S. economy is zero. ...there is no basis to conclude that the input price differential is different from zero. This result arises because the average of a highly volatile short-term input price differential provides a poor basis to predict future input price behavior."

The current ETI report asserts that there is an inconsistent use of the input price

differential in computing TFP and its use in the X factor.[45] The ETI report continues to

confuse the calculation of an historical rate of TFP growth with the establishment of an X

factor. To calculate an historical TFP growth rate, one must use actual prices for the time

period being analyzed. The computation of post-divestiture TFP growth for the LECs did

precisely this: it used input prices for that period.

The computation of an X factor, however, requires the best projection of the forward-

looking TFP differential and the forward-looking input price differential. Given the stable

differential in TFP growth between the telephone industry and the U.S. economy, the

measured post-divestiture TFP differential is as good a predictor as the long-term trend

because they are virtually the same. For the input price differential, the short-term (post-

divestiture) experience is not a good predictor because it reflects the highly specific

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[44] Public Utilities Commission of the State of California, Interim Opinion, Decision 95-12-052, December 20, 1995, pp. 67-68.
[45] ETI Report, pp. 42-45.

influence of a specific historical pattern of declining interest rates, and it differs greatly from the long-term trend.

The ETI report continues to exhibit a basic misunderstanding or mischaracterization of capital computations in TFP studies and relies on this basic error to assert that the input price results were "cherry-picked" to come up with the most financially advantageous result for USTA.[46] For each category of cost, ETI argues that cost is equal to price times quantity. But capital costs can not simply be observed from the LECs books, and then divided into a price and a quantity component. Rather, the quantity of capital stock and the implicit rental price of that stock are computed, and their product is the total economic cost of capital services.[47] Therefore, it is not the case (contrary to ETI's incorrect assertion) that any adjustment in either the price or quantity of capital must lead to an offsetting adjustment in the other--because the adjustment in either price or quantity will also result in a change in capital cost.

Input Prices From the Simplified Christensen LEC TFP Study. In our comments, we introduced the simplified TFP methodology that relies completely on publicly-available data. Input price growth from the simplified model for the 1984-1994 period are reported below, along with U.S. economy input price growth. Given the TFPRP model for the expanded eleven company sample was only estimated for 1988-1994 (providing growth rates for the 1989-1994 period), we had to combine the results of the TFPRP model with the 1984-1988 results of the simplified study on the original nine

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[46] ETI Report, p. 44.
[47] In the simplified Christensen model, all data used in the computation of capital quantity, price and total cost are publicly available and verifiable.

company sample (providing growth rates for the 1985-1988 period) in order to come up with a complete series for the 1984-1994 period. The results are presented below in Table 3.

Table 3
Input Price Growth for the Simplified Christensen
LEC TFP Study, 1984-1994

Year	LEC Input Price Growth	US Economy Input Price Growth	Input Price Differential
1984			
1985	0.0%	4.0%	-4.0%
1986	5.4%	3.8%	1.6%
1987	1.0%	3.2%	-2.2%
1988	0.8%	4.3%	-3.5%
1989	-3.0%	4.1%	-7.1%
1990	3.7%	4.2%	-0.5%
1991	3.5%	2.9%	0.6%
1992	5.4%	4.6%	0.8%
1993	5.1%	3.5%	1.6%
1994	2.8%	3.3%	-0.5%
Average 1984-1994	2.5%	3.8%	-1.3%
Average 1989-1994	4.1%	3.7%	0.4%

As with the original and updated LEC TFP studies, the input price differential is statistically insignificant over the 1984-1994 period. In fact, the average over the last five-year period, 1989-1994 period is _positive_. The results of the statistical tests are found below in Table 4. It can be seen that the t values for the 1984-1994 and the 1989-1994 period are both well below their respective critical values[48], indicating the input price differential is not statistically different from zero.

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[48] The critical value reported is for a 95% confidence region. If the t-value is greater than the critical value this shows that the input price differential is statistically significant. If the t-value is less than the critical value it is statistically insignificant.

Table 4
Test of the Hypothesis that the Input Price Differential is Zero
1984-1994

Period	t value	Critical Value
1984-1994	-1.48	-2.26
1989-1994	0.94	2.78

XIV. The ETI Report Inaccurately Portrays the Christensen LEC TFP Study.

The ETI report goes to great lengths to report on the California proceedings in which Dr. Christensen testified for Pacific Bell and entered his LEC TFP study in the record.[49] However, the ETI report errs in its portrayal and fails to recognize two key points. First, the corrections represented minor changes in data that were done in the normal course of updating the study and had minimal impact on the results. Second, the California Commission recognized the minor nature of the revisions and not Dr. Selwyn's distorted, overblown characterization of the revisions.

Once again, as reported in the following table, the data corrections had only a minor impact on the LEC TFP study. Table 5 compares the 1984-1992 average annual growth rates of the original Christensen LEC TFP study and the updated study that incorporated the data corrections.[50]

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[49] Public Utilities Commission of the State of California, Investigation No. 95-05-047.
[50] The 1984-1992 period is used because it represents the common period covered by the two Christensen LEC studies.

Table 5
Comparison of Results for Original and
Updated Christensen LEC TFP Studies
1984-1992

	Original Christensen Study	Updated Christensen Study	Difference
Output Quantity	3.5%	3.4%	-0.1
Input Quantity	0.9%	1.0%	+0.1
TFP	2.6%	2.4%	-0.2
U.S. TFP	0.3%	0.3%	0.0
TFP Differential	2.3%	2.1%	-0.2

It can be seen that the average annual LEC TFP growth changed from 2.6% to 2.4% and the differential changed from 2.3% to 2.1%, a minimal change.

ETI speculates that "the 1993 update would appear to have been motivated by the Bureau of Labor Statistics (BLS) downward revision to the economy-wide productivity growth rate, announced in the summer of 1994, from 0.9% to 0.3%. ... a reduction in the economy-wide productivity growth rate from 0.9% to 0.3% produces a 0.6% increase in the X-factor, worth approximately $1.5 billion in revenues to the LECs over the next four years."[51] This speculation is incorrect. Prior to performing the update, we had no reason to expect a downward revision in LEC TFP growth. For all we knew, the update could have produced a higher LEC TFP figure, which would have reinforced the downward BLS revision in the U.S. figures.

It is standard procedure to update economic studies as more recent or better

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[51] ETI Report, p. 10.

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data become available. Most data series published by the U.S. government are revised

on a regular basis and researchers routinely use the revised data. Irrespective of any

change in results, ETI's claims of data manipulation in the Christensen LEC TFP study

are totally unfounded. In any event, the changes were minor with no impact on the

conclusions of our original study.

The recent decision by the California PUC in Phase I of I.95-05-047 recognized the

distorted and overblown nature of Dr. Selwyn's assertions in that case, which have

been repeated in the ETI report in this proceeding. That decision overturned a

Proposed Decision by the Administrative Law Judge in that proceeding. Specifically,

the California decision states:[52]

> Moreover the Proposed Decision errs in misinterpretation (sic) CCLTC's assertion
> that the number of errors are substantial as a characterization that the study was
> substantially in error. Even if the number of errors detected and corrected was
> large, the overall effect of these corrections and changes was minimal, resulting in
> an adjustment of two tenths of one percent in the LEC TFP. Thus, the core value
> of this study remains.
>   ...Dr. Christensen is a nationally recognized expert in productivity analysis
> with a substantial record of original research and publications in journals subject
> to peer review. Other parties used his study as a starting point from which they
> deviated. The simple updating of statistics that Christensen performed is a
> routine professional practice. In addition, the lack of "purity" cited in the PD
> would virtually disqualify all empirical studies from use in our proceedings. Data
> problems are common in all applied research and do not, by themselves,
> disqualify a study.

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[52] Public Utilities Commission of the State of California, Interim Opinion, Decision 95-12-052, December
20, 1995, pp. 65-66.

XV. Conclusion

After careful review of the Norsworthy and ETI statements, we have found none of the criticisms to be justified. Many of the criticisms are based on a misunderstanding of the data used in the Christensen TFP models. Other criticisms are based on a misunderstanding of the methods used to compute TFP or on incorrect inferences from economic theory. None of the criticisms lead to the conclusion that the simplified TFP model needs to be corrected in any way.

We find that the only economically meaningful measure of productivity is LEC total factor productivity and that any measure of "interstate productivity" is not economically meaningful. We furthermore find that the alternative methods offered by Norsworthy and ETI for measurement of output, capital, and materials contain fundamental flaws and are inappropriate for purposes of measuring LEC productivity. Finally, we find that the simplified TFP model needs no modification, and is the appropriate basis for measuring LEC TFP.

ATTACHMENT B

"Economic Evaluation of Selected Issues from the Fourth Further Notice of Proposed Rulemaking in the LEC Price Cap Performance Review:
Reply Comments"

William E. Taylor, Timothy J. Tardiff, and Charles J. Zarkadas

National Economic Research Associates, Inc.

USTA Reply Comments 3/1/96

ECONOMIC EVALUATION OF SELECTED ISSUES

FROM THE FOURTH FURTHER NOTICE OF

PROPOSED RULEMAKING IN THE

LEC PRICE CAP PERFORMANCE REVIEW:

REPLY COMMENTS

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March 1, 1996

TABLE OF CONTENTS

I.   EXECUTIVE SUMMARY

This paper responds to three issues presented in the Statement of Dr. John R. Norsworthy, Appendix A to the *Comments of AT&T* filed in the CC Docket No. 94-1.[1] First, we demonstrate that the "Performance-Based Model" (PBM) is inconsistent with sound economic theory and practice and, therefore, does not produce a meaningful measure of productivity. Second, we confirm our finding reported in our earlier comments that input price inflation rates for the Local Exchange Carriers (LECs) do not differ significantly from the input price inflation rate for the economy as a whole. Dr. Norsworthy's arguments to the contrary are without merit. Third, we explain why revenue weights, which are standard practice in productivity studies, are superior to the cost-based weights advocated by Dr. Norsworthy.

A. Dr. Norsworthy's "Performance-Based Model" Does not Produce Reliable Productivity Results

The "Performance-Based Model" is AT&T's second attempt to base the productivity offset (X factor) on the LECs' accounting rate of return. Like its predecessor, the "Historical Revenue Model" (HRM), AT&T's current approach attempts to infer high productivity growth from high accounting earnings—in effect, an attempt to turn an economic vice into a regulatory virtue. In fact, Dr. Norsworthy's attempt to use accounting rates of return to infer anything meaningful about the productivity performance of the LECs flies in the face of both economic theory, which has long recognized the errors that accounting results produce, and sound productivity studies, exemplified by the work done by Christensen and Associates in this investigation.

In particular, by (i) using accounting returns and depreciation in place of the correct economic values for these measures and (ii) treating capital expenditures as the difference

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[1] *Statement of Dr. John R. Norsworthy: Analysis of the TFP Methods for Measuring The X-Factor of the Local Exchange Carriers' Interstate Access Services,* Appendix A to the "Comments of AT&T" in CC Docket No. 94-1, dated January 11, 1996. Hereafter referred to as "Norsworthy."

between revenue and non-capital expenditures, Dr. Norsworthy creates an invalid measure of capital price, the amount of capital used by LECs, and, therefore, the productivity that LECs have historically realized. These conceptual problems are compounded by a number of calculation errors in the "Performance-Based Model" computer program.

B. LEC Input Price Inflation is Not Significantly Different from Economy-Wide Input Price Inflation

In setting a forward-looking productivity target, a key question is whether input price inflation for the LECs *will differ* from economy-wide input price inflation. A careful analysis of long-term input prices demonstrates that the most reliable estimate of an input price differential is zero. In fact, although LEC input prices did grow more slowly in the years immediately following divestiture, they grew *faster* in the most recent years. Thus, the forecast of a zero differential is conservative in this light.

Dr. Norsworthy's attempt to demonstrate that a input price differential should be included in the productivity target is based on a mischaracterization of our previous analysis as well as a meaningless test of the *pattern* of LEC and economy-wide input price changes in place of the correct test of the difference in average price change. Thus, Dr. Norsworthy's analysis does not undermine our earlier result, which has, in fact, been corroborated by the input price series in his own and Dr. Christensen's recent studies.

C. Revenue versus Cost Weights

The purpose of the productivity target in a price cap plan is for revenues to track costs when the LEC meets the expected productivity target. Economic theory demonstrates that a productivity study that combines output quantities with revenue weights satisfies this objective. When prices differ from marginal costs, the cost-based weights proposed by Dr. Norsworthy are inconsistent with the purpose of the productivity target.

Intuitively, using marginal cost weights to combine growth rates of individual outputs is incorrect in this context because it fails to account for the fact that the growth of outputs which are sold for a high margin (price less marginal cost) contribute more towards revenue growth